

## PATENT SPECIFICATION

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## DRAWINGS ATTACHED

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## (54) IMPROVEMENTS RELATING TO WINDOWS

(71) We, OASIS VACUUM GLAZING LIMITED, a British Company, of Visijar House, Pegasus Road, Croydon Airport, Surrey CR9 4PR, Great Britain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to windows, and the combination thereof with alarm means. The present invention is a window comprising two panes of glass having the same major dimensions and spaced apart in parallel relationship by a sheet of plastics material disposed therebetween, remote from their edges, said sheet being of the same shape as, but slightly smaller than, the panes, and being provided on both 15 major surfaces with protuberances spacing said panes therefrom, said sheet having at least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes together at 20 their edges, said panes containing a vacuum therebetween, and that one of the said panes which in use is the inner pane having therein a hole through which the cavity or space was evacuated and which is plugged.

25 The present invention is also a window comprising two panes of glass having the same major dimensions and spaced apart in parallel relationship by a sheet of plastics material disposed therebetween remote from their edges, said sheet being of the same shape as, but slightly smaller than, the panes, and being formed on both major 30 surfaces with local projections which space said panes from said sheet, said sheet having at least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes, and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes together at 35 their edges, said panes containing a vacuum therebetween, and that one of the said panes which in use is the inner pane having therein a hole through which the cavity or space was evacuated and which is plugged.

35 The present invention is also a window comprising two panes of glass having the same major dimensions and spaced apart in parallel relationship by a sheet of plastics material disposed therebetween remote from their edges, said sheet being of the same shape as, but slightly smaller than, the panes, and being formed on both major 40 surfaces with local projections which space said panes from said sheet, said sheet having at least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes, and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes together at 45 their edges, said panes containing a vacuum therebetween, and that one of the said panes which in use is the inner pane having therein a hole through which the cavity or space was evacuated and which is plugged.

surfaces with local projections which space said panes from said sheet, said sheet having at least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes, and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes together at 50 their edges, said panes containing a vacuum therebetween, and that one of the said panes which in use is the inner pane having therein a hole through which the cavity or space was evacuated and which is plugged.

55 The sheet of plastics material may be clear or coloured and the protuberances or local projections may be formed by heat treatment, be moulded or be separate elements secured to the sheet by adhesive. 60 In place of local projections a series of parallel lines may be used extending the full length or breadth of the sheet of plastics material on both sides thereof and proud thereof using nylon thread or thin wire. The 65 nylon thread or thin wire may be adhered to the sheet or may be moulded into the plastics material. The plastics material may be, for example, an ACRYLIC such as PERSPEX or PLEXIGLAS or a 70 POLYCARBONATE such as LEXAN or MAKROLON (PERSPEX, PLEXIGLAS, LEXAN and MAKROLON are Registered Trade Marks). The protuberances or projections are preferably directly opposite 75 one another on the two major surfaces.

The present invention is also the combination with alarm means of a window closing an opening and comprising two panes of glass having the same major 80 dimensions and spaced apart in parallel relationship by a sheet of plastics material disposed therebetween remote from their edges, said sheet being of the same shape as,

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but slightly smaller, than, the panes, and being provided on both major surfaces with protuberances spacing said panes apart, said sheet having at least one hole extending 5 between said major surfaces, said sheet being symmetrically disposed between said panes, and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes 10 together at their edges to define between same and the sheet of plastics material two intercommunicating cavities or spaces wherein the pressure is less than the external pressure, the lesser pressure holding in the 15 closed circuit condition a switch device plugging a hole through which said cavities or spaces were evacuated and which is in the inner one of said panes, said switch device interrupting an electrical circuit and being 20 adapted, on equalization of the pressures within and external of the window, to operate the alarm means.

The present invention is also a method of closing an opening providing access to a 25 room interior, said method comprising fitting said opening with a window comprising two panes of glass of the same major dimensions and spaced apart in parallel relationship by a sheet of plastics material 30 remote from their edges, said sheet being of the same shape as but slightly smaller than, the panes, and being provided on both major surfaces with protuberances spacing said panes therefrom, said sheet having at 35 least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes and the peripheral edges of said sheet sealing against a backing means located between said panes 40 and sealing said panes together at their edges to define between same and the sheet of plastics material two intercommunicating cavities or spaces to which access is afforded from the inner side of the window by 45 an orifice in the inner pane, creating in said cavities or spaces by evacuation of air therefrom a pressure less than that outside the window, and plugging said orifice by a switch device set to be in the closed circuit 50 condition during continuance of the differential pressures and on equalization of the pressures to be brought to the open circuit condition to operate alarm means.

Embodiments of the invention will now be 55 described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a cross-section through a window according to the present invention;

Fig. 2 is a section on the line II—II of Fig. 1 showing, in effect, an elevation of a window according to the present invention with the front or outer pane of glass removed;

Fig. 3 is a view similar to Fig. 1 but with

the plug assembly of Fig. 1 replaced by a switch device capped for connection of the switch device to an alarm device (not shown);

Fig. 4 is a view similar to Fig. 2 but illustrating a different manner of spacing the panes of glass from the intermediate sheet of plastics material; and

Fig. 5 is a cross-section through a bullet-resistant window.

Referring firstly to Figs. 1 and 2 of the drawings, the window comprises two panes of glass 10 and 11 each measuring, say four feet square, which are disposed in parallel relationship and are separated by a sheet 12 of plastics material which may be clear or clooured and is provided on both of its major surfaces with local small protuberances or projections 13 spacing the panes 10 and 11 from the sheet 12 to define cavities of say 0.020 to 0.040 of an inch in thickness. The spacer elements are preferably directly opposite one another on the opposite sides of the sheet and may be formed by heat treatment of the sheet or be moulded, or be adhered to the sheet. The plastics material may be an ACRYLIC or POLYCARBONATE. The sheet is dimensioned relative to the panes such that there is between the panes a peripheral recess backed by the periphery of the sheet. A length of resilient material 14, such as rubber or plastics material, preferably of circular section, which allows turning at the corners without deforming, is disposed in the recess hard against the sheet periphery. The material is of a diameter slightly greater than the distance between the panes to ensure that the seal is under compression when the window is complete. The recess is deeper than it is wide, and after the length of resilient material is in position with its ends overlapping to form a joint, the remainder of the recess is filled with a filling 15 of epoxy polysulphite or other sealing compound which is pressed into the recess against the inner seal provided by the length of resilient material. It will be noted from Fig. 2 that the sheet 12 is provided with a number of peripheral notches 16 which ensure intercommunication between the two cavities for both inflow and outflow of air.

A small hole of, say, about 3/10" diameter, is provided in the pane 11, which in use will be the inner pane, the hole being adjacent to one corner of the pane. This hole is used for evacuating air from the spaces or cavities between the panes 10 and 11 on the one hand, and the sheet 12 on the other hand, which spaces or cavities are bounded by the sealing means 14, 15. The pump used in such evacuation is one which automatically pushes a plug into the hole when the desired degree of vacuum has

been obtained. This may be of the order of ten to fifteen inches of mercury.

The plug is denoted 17 in Fig. 1 and has a threaded stem 18 and a screw-driver slot 19 to screw the plug into or unscrew same from a tapped stem 20 in a bush 21. The stem 20 has a peripheral groove 22 which assists adhesion of the stem to the surround of the hole by means of a suitable connecting compound such as ARALDITE (Registered Trade Mark). Two longitudinal grooves 23 are formed in the stem adjacent the tapped opening therein and extend completely through the bush. A recess 24 is turned in the top of the bush.

The head of the plug 17 has a peripheral flange 25 and the relative dimensions of the head of the plug and the head of the bush are such that a small clearance is left between the flange 25 and the periphery of the head of the bush, and an O-ring seal 26 coated with silicone grease is compressed in said clearance as the plug 17 is screwed into position.

If the window just described is to be combined with alarm means, the plugging of the hole in the inner pane 11 is effected by a switch device 30 (Fig. 3), communicating through the hole with the two cavities. The switch device is adapted to be held in the closed circuit condition by the differential pressures on the two sides of a diaphragm. The alarm means is incorporated into an electrical circuit which includes the switch device, and if the vacuum in the cavities is destroyed, the diaphragm moves to open the switch contacts and thus operates the alarm means.

Referring now to Fig. 3 of the drawings, the switch device 30 comprises a disc-shaped base plate 31 with a peripheral flange 32 and a central threaded stud 33 which screws into the tapped opening in the stem 20 of the bush 21. The dimensions of the base plate 31 and the head of the bush 21 are such that the small clearance is left between the flange 32 and the periphery of the head, and the O-ring seal 26 coated with silicone grease is compressed in said clearance as the switch device 30 is screwed into position.

An outer circular plate 34 is held in spaced and parallel relation to the base plate 31 by an annular spacer 35 of ceramic or other electrical insulating material which both seals the space 36 between the plates and locates in position a diaphragm 37 which has a central contact 38 of precious metal such as platinum proud of its surface opposed to the base plate 31. A hole 68 is provided in the base plate to communicate with the recess 24, so that the switch space 36 communicates with the space or cavity between the panes 10 and 11.

The stud 33 has a central tapped opening

with a fine thread and in this is engaged a threaded pin 39 at whose end opposed to the diaphragm 37 is a contact 40 also of precious metal such as platinum. The pin 39 enables adjustment of the setting of the switch device 30. The plate 31 has two small holes 41 therein for engagement by a suitable tool when assembling the switch device 30 to the bush 21. A small hole 42 is provided in the plate 34 so that the side of the diaphragm 37 remote from the base plate 31 is connected to atmosphere to ensure there is no air lock to restrict the operation of the diaphragm 37.

On the spaces or cavities between the panes 10 and 11 on the one hand and the sheet 12 on the other hand being evacuated to provide therein a vacuum of the order of, say, 2.5 inches Hg, the diaphragm 37 is drawn inwards and the contacts 38 and 40 close together. This locks the relay and the alarm system is inoperative. When the pressure in the spaces or cavities increases and attains equality with the atmospheric pressure, the diaphragm 37 flexes outwardly and pulls the contact 38 from the contact 40, breaking the electrical circuit and releasing the relay, thus operating the alarm system.

Fig. 3 also illustrates one method of connecting the switch 30 with an alarm device (not shown). A metal cap 45 is fitted over the switch 30 and is held in position by a circlip 46. A spring 47 provides the electrical connection between the plate 34 of the switch 30 and a contact 48 insulated from the cap 45 by a layer 49 of insulating material. The spring 47 also ensures that there is a tendency for the cap 45 to be forced off the switch 30, and this causes pressure to be exerted on the circlip 46. A contact 50 is secured directly to the cap 45 and provides electrical continuity for a wire from the alarm circuit (not shown) via the cap 45 and the base plate 31 to the contact 40. A hole 51 is provided in the cap 45 for through passage of the conducting wires from the alarm system to the switch. When testing the vacuum in the window, the cap 45 is removed from the switch 30 by removing the circlip 46. This removes the electrical circuit of the alarm system from the switch.

Fig. 4 illustrates an alternative to the small protuberances or projections 13 on the sheet 12 of plastics material. In this instance, there are provided on both sides of the sheet 12 nylon cords or wires 55 which are directly opposed on the two sides of the sheet and extend along parallel lines between notches 16 at opposed ends of the sheet, the cords or wires stopping short at the notches and not impeding free flow of air between the two cavities. The cords or wires 55 may be located in parallel grooves in the surfaces of the sheet and be bonded in position to be proud of said surfaces. Alternatively, the

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cords or wires 55 are moulded in position.

Fig. 5 illustrates the incorporation of an alarm window 60, such as described with reference to Fig. 3, in a bullet-resistant window. The bullet-resistant window is made up of the alarm window 60, a laminated glass window 61 spaced rearwardly thereof, and a relatively thick sheet 62 of plastics material disposed intermediate the windows 60 and 61, the assembly of windows and sheet being mounted in a frame 63 having flanges 64, 65, 66 and 67 disposed to position the parts 60, 61 and 62 properly in relation to one another. It will be noted that the sheet 62 slopes rearwardly from top to bottom but it may also be disposed parallel to the windows 60 and 61. The alarm window, being disposed at the front facing the direction in which an attack might be anticipated, ensures that the alarm is raised immediately following the firing of the first bullet. The various layers of glass and plastics material will resist the passage of the bullet. The alarm switch may be fitted either on the front or rear pane of the alarm window 60.

Windows as described could be fitted, for example, in jewellers' shops, banks, private homes and show cases to set off an alarm should a window be broken, cut, or removed.

A vacuum of ten to fifteen inches of mercury has been found to give good sound insulation and also to improve heat insulation. Windows according to the invention can be moved to different altitudes with the vacuum sealed, or the vacuum can be adjusted as required at the site.

Plate glass or toughened glass could be used in windows according to the invention. The sheet of plastics material will delay entry through the window and will also increase the thermal insulation because of the two cavities. Moreover, in the window construction shown and described, the sheet of plastics material is free to move, because of the resilient material 14, on differential thermal expansion between same and the panes of glass.

#### 50 WHAT I CLAIM IS:

1. A window comprising two panes of glass having the same major dimensions and spaced apart in parallel relationship by a sheet of plastics material disposed therebetween remote from their edges, said sheet being of the same shape as, but slightly smaller than, the panes, and being provided on both major surfaces with protuberances spacing said panes therefrom, said sheet having at least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes, and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes

together at their edges, the contained gaseous volume being at a pressure less than that external to the window, and that one of said panes which in use is the inner pane having therein a hole through which the cavity or space between the panes was evacuated and which is plugged.

2. A window comprising two panes of glass having the same major dimensions and spaced apart in parallel relationship by a sheet of plastics material disposed therebetween remote from their edges, said sheet being of the same shape as, but slightly smaller than, the panes, and being formed on both major surfaces with local projections which space said panes from said sheet, said sheet having at least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes, and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes together at their edges, said panes containing a vacuum therebetween, and that one of the said panes which in use is the inner pane having therein a hole through which the cavity or space was evacuated and which is plugged.

3. A window according to claim 1 or 2, wherein the sheet of plastics material is clear.

4. A window according to claim 1 or 2, wherein the sheet of plastics material is coloured.

5. A window according to any preceding claim, wherein the protuberances or local projections are formed by heat treatment.

6. A window according to any one of claims 1 to 4, wherein the protuberances or local projections are moulded.

7. A window according to any preceding claim wherein the protuberances or local projections are separate elements secured to the sheet by adhesive.

8. The combination with alarm means of a window closing an opening and comprising two panes of glass having the same major dimensions and spaced apart in parallel relationship by a sheet of plastics material disposed therebetween remote from their edges, said sheet being of the same shape as, but slightly smaller than, the panes, and being provided on both major surfaces with protuberances spacing said panes apart, said sheet having at least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes, and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes together at their edges to define between same and the sheet of plastics material two intercommunicating cavities or spaces wherein the pressure is less than the external pressure, the lesser pressure holding in the

closed circuit condition a switch device plugging a hole through which said cavities or spaces were evacuated and which is in the inner one of said panes, said switch device interrupting an electrical circuit and being adapted, on equalization of the pressures within and external of the window, to operate the alarm means.

9. A method of closing an opening providing access to a room interior, said method comprising fitting said opening with a window comprising two panes of glass having the same major dimensions and spaced apart in parallel relationship by a sheet of plastics material disposed therebetween remote from their edges, said sheet being of the same shape as, but slightly smaller than, the panes, and being provided on both major surfaces with protuberances spacing said panes therefrom, said sheet having at least one hole extending between said major surfaces, said sheet being symmetrically disposed between said panes and the peripheral edges of said sheet sealing against a backing means located between said panes and sealing said panes together at their edges to define between same and the sheet of plastics material two intercommunicating cavities or spaces to which access is afforded from the inner side of the window by an orifice in the inner pane, creating in said cavities or spaces by evacuation of air therefrom a pressure less than that outside the window, and plugging said orifice by a switch device set to be in

the closed circuit condition during continuance of the differential pressures and on equalization of the pressures to be brought to the open circuit condition to operate alarm means.

10. A window substantially as hereinbefore described with reference to Figs. 1 and 2 of the accompanying drawings.

11. The combination of a window with alarm means substantially as hereinbefore described with reference to Fig. 3 of the accompanying drawings.

12. A window substantially as hereinbefore described with reference to Fig. 4 of the accompanying drawings.

13. A bullet-resistant window comprising a combination according to claim 8, with the window of said combination mounted in a frame in spaced and parallel relation to a laminated glass window with a relatively thick sheet of plastics material disposed intermediate said window of said combination and said laminated glass window and spaced from both.

14. A bullet-resistant window substantially as hereinbefore described with reference to Fig. 5 of the accompanying drawings.

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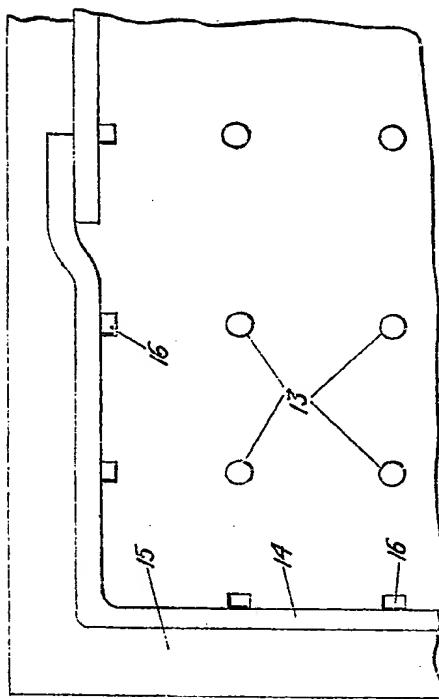
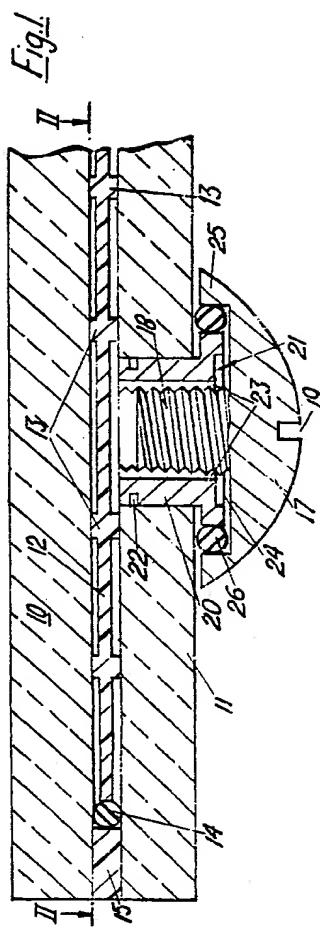
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COMPLETE SPECIFICATION

3 SHEETS

*This drawing is a reproduction of  
the Original on a reduced scale  
Sheet 1*



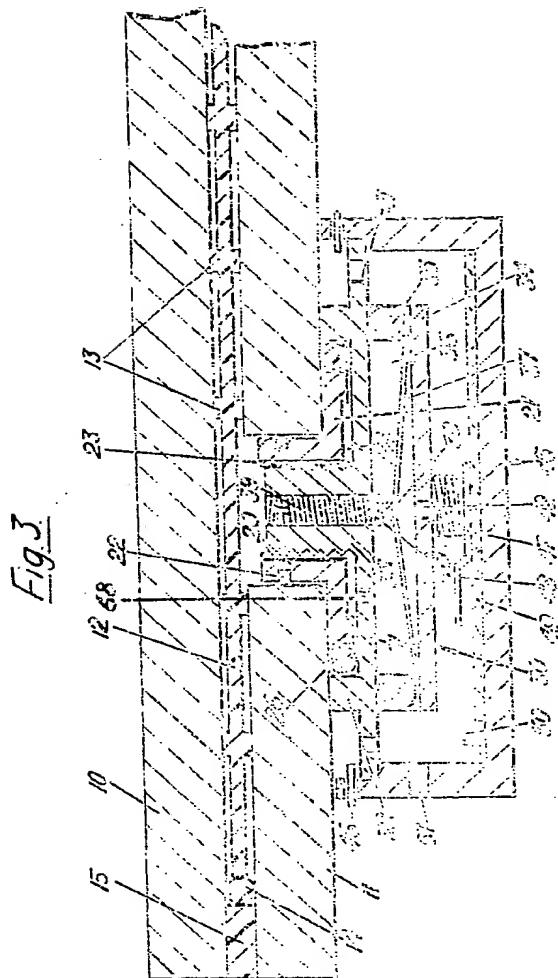
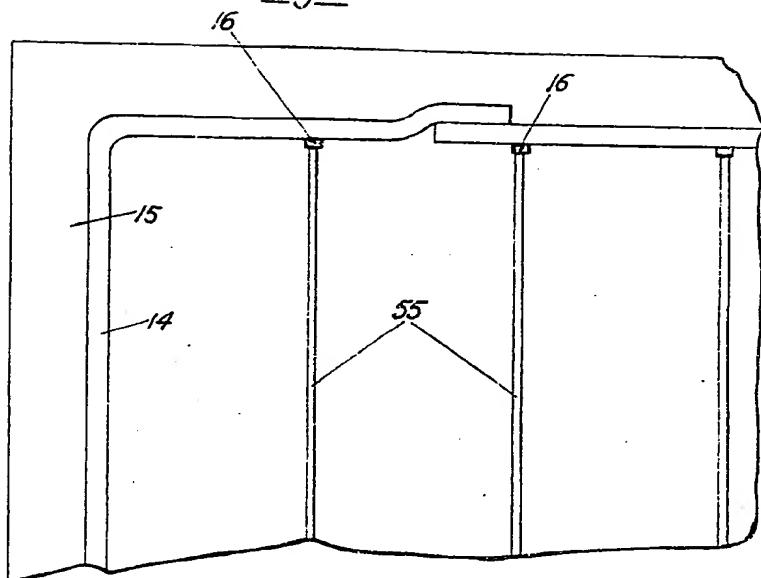


Fig.4.Fig.5.